THE LOWER BENGAL (BURDWAN) EPIDEMIC FEVER REVIEWED AND COMPARED WITH THE PRESENT ASSAM EPIDEMIC MALARIAL FEVER (KALA-AZAR)

Leonard ROGERS

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THE LOWER BENGAL (BURDWAN) EPIDEMIC FEVER REVIEWED AND COMPARED WITH THE PRESENT ASSAM EPIDEMIC MALARIAL FEVER (KALA-AZAR).

By Surgn-Capt. Leonard Rogers, I.M.S., M.B., B.S. (Lond.); F.R.C.S (Eng.)

The epidemic of malarial fever which spread over a large part of Lower Bengal in the period comprised between the years 1850 and 1875 excited an immense amount of controversy while it lasted, yet it may be safely asserted that in spite of the numerous theories which were put forward to account for the phenomena witnessed, no complete and satisfactory explanation of the epidemic considered as a whole has ever been propounded. Nor is this surprising when it is considered that at the time of the controversy the prevalent ideas with regard to the nature of malarial fevers were of the vaguest kind and the existence of the malarial organism was not then discovered, and it was not until a considerably later period that any attention was directed to it in India.

In the course of my recent investigation of the epidemic fever of Assam, which is locally known under the name of "Kala-azar," I was so much struck by the close resemblance between this latter outbreak of a spreading fever in Assam with that known in Bengal under the name of the "Burdwan fever," that I at first thought the two epidemics might possibly be continuous. This led to an examination of the old Bengal reports and other literature on the subject, much of which was very kindly obtained for me by Mr. Cotton, the Chief Commissioner of Assam. The result was that, although the two outbreaks were found to be independent of each other, and differ somewhat in the type of fever as is shown in section VIII of my report* on the Assam epidemic, yet the resemblance between the two phenomena are so minute that I am convinced that they are of precisely the same nature and have a similar origin. As, moreover, the Assam epidemic is the first instance of this nature, which has been investigated in the light of modern pathological knowledge, the results obtained have an important bearing on the true nature of the Lower Bengal outbreak. It will then I hope not be without interest to briefly review the former epidemic in the light of modern knowledge, especially as these epidemics have been responsible for a fearful yearly mortality extending over a period of half a century, and in some places completely depopulating whole tracts of country, while there is good reason to believe that in former centuries no less destructive epidemics of a similar nature have occurred, while the extraordinary influences which gave rise to these may at any time recur with a like result.

I propose in this paper firstly, to give a very brief outline of the Lower Bengal epidemic as a whole; secondly, to discuss the theories which have previously been advanced to explain it and to show their inadequacy; and thirdly, after pointing out the real origin of the epidemic as far as it can now be ascertained from the early records, to give what I believe to be the true explanation of the occurrence as seen from the present standpoint of scientific knowledge. The Assam epidemic will only be referred to in as far as it illustrates and confirms the facts and reasoning with regard to the Burdwan fever, but no attempt will be made here to give any systematic account of "kala-azar" as this has been fully done in my report on the subject.

A general idea of the epidemic may best be conveyed by the following abstracts from the Bengal census report of 1881:—

"The only division of Bengal which shows a decrease (in the population) is one which a quarter of a century ago was considered one of the most salubrious in the province. The history of the decrease of the population in the Burdwan division is the history of the famous Burdwan fever. It is true that this terrible epidemic did not claim so many victims in the decade which has just elapsed as in that which preceded it, but the ravages of the disease have not yet been repaired, the ruined villages have not yet been rebuilt, jungle still flourishes where populous hamlets once stood, and while many of those who fled before the fever have not returned, the impaired powers of the survivors have not sufficed to fill the smiling land with a new population. How this terrible disease was generated and how it extended, are questions still debated among those most competent to give an opinion on the subject; and one solution of the difficulty is that a change took place in the characteristics of the fever during the twelve years that it prevailed, so that the disease which was so fatal in 1873 was not the same as that which decimated the population in 1862. That it was a malarious fever is universally admitted, and that by some means or other it travelled steadily in a general direction from east to west is beyond controversy; but here unanimity ceases." After quoting the Sanitary Commissioner for Bengal, who spent several months of two years in studying the disease in the affected districts, and whose invaluable report will be referred to again later, as writing in 1874 "the fever, originally malarious, acquired either in Jessore or Nadia

* The report has just been published by the Assam Secretariat Press and can be obtained either from them or from Messrs. Thacker, Spink & Co., Calcutta.

contagious properties," in support of which he urged that the advance of the epidemic followed the main roads and the chief lines of traffic and, that it did not spread in any direction where means of communication did not exist; while, on the other hand, other authorities assert that the fever though malarious was not contagious, the writer sums up: "On the whole, it may probably be concluded that the disease was a malarious non-contagious fever; that its advance along roads and lines of communications was a coincidence, merely the fact being that it was not communicated by travellers, but that it found in the large villages and bazaars, which are inseparable from lines of traffic and centres of trade, a set of insanitary conditions most favourable to its development, that it was a malarious fever rendered malignant wherever specially evil conditions favoured its development, and that it travelled steadily in a given direction in obedience to some law which has not yet been discovered, unless that of a general and progressive obstruction of drainage over the whole affected area provides a satisfactory solution of the difficulty."

It will be seen from the above paragraph that the obstructed drainage theory failing to explain the facts, the writer in order to escape admitting that a purely malarious fever may become infectious has to fall back on supposition which necessitates the admission that the disease arose *de novo* in each of the places that it affected, which opinion in these days needs scarcely be seriously discussed. To continue the quotation:—

"That the fever did travel is no matter for doubt. Like the waves of a flowing tide it touched a place one year and receded, reached it again next year with greater force and again receded, repeating this process until the country was wholly submerged and the tide passed further on. During the first year of its invasion the fever was mild; there was a simultaneous increase of the general fever, endemic fever, and a subsidence of both, usual at the end of the fever season. In the second year the fever began earlier than the ordinary country fever and earlier than the epidemic fever of the year before previous year; it also lasted longer and caused greater mortality. During the third year the disease was marked by still larger fatality both from primary attacks and secondary complications, the systems of those who had survived the two previous years being now so saturated with malaria that they had little power to resist the attacks of the fever and fell rapid victims to it. During the fourth, fifth and sixth years,—six years being the average duration of the fever in any place,—there was a general and slow recovery, the fever in each successive year attacked fewer persons, was of a less fatal type, and prevailed for a shorter period, finally disappearing altogether in the seventh year, but leaving many of its victims with a permanently enlarged spleen and other complications to indicate the trial which the system had undergone.

Every word of the last paragraph is literally true of the Assam epidemic called "Kala-azar," although it was written before the latter had attracted any attention. Let us now see what was the general course of the Lower Bengal epidemic fever, which is a much better name than "The Burdwan Fever" as this was only one of several districts that it effected. To continue the above quotation:—

"This fever, as has been said above, invaded the Burdwan division from the East. It appears to have originated in the Eastern part of the Presidency Division some thirty years ago. Fever was very fatal in Jessore district in the years 1847 and 1848, and after a temporary cessation it broke out again in 1854-56. About this time it began to spread westward to Nadia and the 24-Parganas, and finally culminated in the severe epidemic which devastated those districts from 1857 to 1864. No notice of this fever seems to have been taken by the authorities until the end of 1861, although it prevailed in a most virulent form in Nadia from the end of 1856. Towards the end of 1861, however, its ravages in the Baraset subdivision and the northern portion of the 24-Parganas attracted the attention of Government, and efforts were made to combat it. A few months later measures of a similar kind were introduced in the Nadia district, and in all the three districts then included in the Presidency Division relief operations were continued till the fever died out in about 1864. Briefly stated, this fever was most severe in the rainy season and the winter of the years 1860 to 1862-63. In the winter of 1863-64 there was a perceptible improvement, and a radical change for the better in that of 1864-65.

"But while the epidemic was wearing itself out in the districts of the Presidency Division where it was first observed, it had spread slowly westward into those of the Burdwan division. The Burdwan district is separated from that of Nadia by the Bhagirati river, and the thannahs of Burdwan which abut on the river are these, *viz.*: Cutwa to the north, Parbasthali in the centre, and Culna to the south. It was in riverside villages of the Culna thannah that the first cases of the epidemic occurred in the year 1862. In 1863 the fever re-appeared in the Parbasthali and Culna thannahs, and attacking first the riverside villages on the river bank, advanced slowly inward, spreading also southward into the northern portion of Hughli. In 1864 and 1865 the fever moved still further westward both in Hughli and Burdwan and extended in a southerly direction through the former district to the boundaries of Howrah. The features of the epidemic in 1866 and 1867 were the same as in 1865, except that there was no further

extension in spread to the south in Hughli and Howrah. In 1868 and 1869 a great advance occurred, the town of Burdwan being invaded in the former year and the epidemic spreading far to the north and south, besides continuing its westerly progress. In 1870 its westward extension was not very great; but on the north it invaded Birbhum, and raged all along an extensive tract on the southern portion of the district, the left bank of the Adjai river. In the following year, 1871, the extent of its advance was unprecedented; for not only did it progress many miles to the westward in Burdwan, but it spread to the north and north-west in Birbhum, and appeared in a large tract of country on the north of Midnapore. By 1872 the utmost westerly limit was attained, for it was arrested by the high land lying in the extreme west of the district and along the Bankura border; but the Birbhum district was devastated still further north than in the previous year, and in the Midnapore district a great southern extension took place, enveloping almost the whole of the north-eastern portion of the district. In 1873 the fever made no further progress in Burdwan; and though still severe in the west, it was dying out gradually in those parts of the district where it had first been observed. In Hughli and Birbhum also there was some slight abatement, but in Midnapore and Howrah the mortality was twice as great as in the preceding year. The year 1874 may be taken as the last year of the epidemic in this division; from all quarters reports came that the fever was less fatal and less prevalent than in previous years. In 1875 the same facts were observed again, and what fever remained there wasted the virulence of the epidemic, and had all the characteristics of the ordinary seasonal malarious fever of the country."

The above extracts will be sufficient to give a general idea of the course of the epidemic, while those who are acquainted with the more recent Assam epidemic fever, or have read my report on the subject, will at once see the great similarity between the two outbreaks. Before passing on to consider the various explanations which have been given of the above described phenomena, it will be advisable to give some further facts with regard to the origin and termination of the Lower Bengal epidemic as any theory must take these into account if it is to be satisfactory.

The origin of the epidemic.

It has been already mentioned that the fever apparently arose in Jessore and spread from there to Nadia. The exact date at which it first attained to this power of spreading from one district to another is somewhat doubtful, as there appear to have been several local outbreaks of unusually severe malarial fever in this district before it began to spread to other districts. Thus Dr. Elliot in his report, on the Burdwan fever published in 1863, writes: "A peculiar type of fever called by natives 'Jor Bekar,' of the same nature as that now prevalent in many of the large villages of the Burdwan and Nadia divisions, seems to have been prevalent in Jessore for many years previously to its first appearance in the district of Nadia. It appeared at Mahomedpore, a large village on the river Ellen Kallee, about 30 miles east of the station of Jessore, in the year 1824 or 1825; next at a place called Dalga, on the Cheetra Nuddee; then at Nuldanga, on the Baeng Nuddee, a few years later; and at Chashra, a damp, unhealthy village rear Jessore, still known as an aguish spot, in the year 1831. The inhabitants of Gud Ghât, a large village twelve miles north of the station, suffered fearfully about the year 1855 or 1856, when many hundreds died before medical aid could be afforded them, and others fled panic-stricken from the place. It is probable that the same type of fever as was common in Rangpur, Dinajpur, Purneah, and some other districts which are now, I understand, pretty healthy."

This last sentence is of great importance as showing that in the middle of this century there was a virulent outbreak of fever in Dinajpur and Rangpur, similar to that of the seventies which I have shown in my report on "Kala-azar" was the origin of the present Assam epidemic malarial fever.

Dr. Elliot continues: "From Jessore it would seem to have passed over to the contiguous district of Nadia about the year 1832 or 1833, attacking first the large and then populous village of Gudkhally, situated between the Hireekhal and the stagnant river Cobbaduck, twelve miles south of Jessore, on the public road leading to Calcutta. He then goes on to trace its slow spread from village to village year by year in this district and through the Nadia, Baraset and Hughli districts into the Burdwan division.

From an examination of the first Bengal sanitary report (1868) in which an account is given of some of the fever epidemics in Jessore and from other literature on the subject, it appears that in addition to the two outbreaks in 1824 and 1831, there were others in 1847-48 and 1854-55 in Jessore, which were attributed to the silting up of the Bhyrub river, which is described as "having formerly been a fine large river, but now much damaged by a bund thrown across it by the proprietor of an indigo concern," various effects to improve the state of this river are recorded. These various fever outbreaks appear to have extended more widely at each recurrence, and to have eventually culminated in the great epidemic, the general course of which has been just described, and which there is no doubt whatever originated in

Jessore. I have not been able to obtain any records of the rainfall in Jessore during these epidemic years, so it is impossible to say whether the primary cause of the outbreaks of fever was a succession of years of abnormal rainfall such as I have shown to have brought about the Rangpur-Assam epidemic, or whether it was the silting up of the Bhyrub river, which, undoubtedly occurred during the years of the epidemics. Very likely the physical changes in the drainage of the district brought about by the silting up of the river was one great factor in making the district more malarial, while the separate outbreaks in Jessore which culminated in the great Lower Bengal epidemic fever were largely influenced by variations in the rainfall in different years. This much at least is certain, that the epidemic did arise in Jessore, and that extraordinary physical changes were going on in the district at the time of its origin might very easily have brought about an increase in the prevalence and virulence of the ordinary inalarial fever of that district, whilst, as I shall show presently, no such adequate cause, for the breaking out of the disease in successive years in the districts which were subsequently invaded, can be found.

The cessation of the epidemic.

Any explanation of the Lower Bengal epidemic fever must also satisfactorily account for the cessation of the spread of the epidemic as well as for its origin if it is correct. It has already been mentioned that the fever ceased to spread westward, when it reached the high rising ground of Chota Nagpur at the border of the Bankura district. It then altered its regular westward course and turned north-west into Birbhum, where it was stayed by the rising ground of the Sonthal Parganas, and south into Midnapore, where it spread as long as it found an alluvial soil, but failed to get a permanent footing on the dry porous laterite soil on which the town of Midnapore itself stands. It attacked places on the edge of the laterite, but for one year only, and after the usual seasonal abatement did not recur the next year as always did on alluvial soil, showing that the *materies morbi* did not get a footing in the laterite soil. This is a point of the utmost importance, but as extracts to prove it have been given in my Assam report, it need not be repeated here. The fact is very well illustrated in maps in Dr. Jackson's sanitary report for Bengal of 1873. Throughout its whole course then, the epidemic has been limited to alluvial soil, which is also essentially true of the Rangpur-Assam epidemic.

Former theories of the origin and nature of the Lower Bengal Epidemic Fever.

We see then that the epidemic arose in Jessore, probably by an increase of the virulence of the ordinary fever of that very malarious district, brought about by physical changes in the drainage of the district, possibly intensified by an abnormal rainfall in certain years, and that from Jessore it spread slowly (from 5 to 10 miles a year) from one district to another for a period of over 20 years, and only died out when it reached the limits of the alluvial soil.

These facts can only be explained in one of two ways; either by a progressive physical change, such as increased waterlogging of the soil which extended in a wave over the affected districts coincidently with the spread of the fever; or by the admission that the fever acquired in Jessore such an increased intensity as to become slowly communicable directly or indirectly from person to person, its spread being only limited by the fact that an alluvial soil was necessary for its propagation.

The first mentioned explanation was that which was most commonly adopted during the prevalence of the epidemic, although towards its close, when the full facts concerning its spread were available, the theory of the infectiousness of the fever received some very strong support.

During the earlier periods of the epidemic certain other explanations were given such as Dr. Elliot's theory that "it is probable that a change from time to time occurs in the type of disease among the people, and that during cycles or periods": or that "of overcrowding, diminished food-supply, defective sanitary arrangements, etc.," of Dr. French, although this last observer looked on these as predisposing only, while he is certain that "it progresses steadily although slowly, it has followed, like a rolling wave, the chief roads or means of communication," and other theories too numerous to mention; of which it will suffice to say, that as there was no evidence that these sanitary conditions had changed to any extent during or shortly before the epidemic, they cannot explain the spread of the fever.

All the theories which attributed the spread of the fever to coincident physical changes in the districts attacked, considered this change to consist in a "waterlogging" of the country, but the ways in which they thought this had been brought about differed with each writer to such an extent that they were actually contradictory.

Thus the three main theories were:—

(1) "A gradual elevation of the fever tracts from East to West" of Dr. David Wilkie;

(2) A "river elevation above the intervening land" of Dr. Coates; and

(3) A waterlogging of the districts by means of railways, embankments, roads and bunds confining the rivers and others obstructing certain watercourses.

Dr. Wilkie, who investigated the fever in Burdwan in 1873, concludes that "there is only one way out of the difficulty; the cause of the fever was a general one, it has entirely passed away or ceased to act," and he finds a solution

of the problem in the remark of the Commissioner of Burdwan that a line separated the healthy and unhealty tracts "which is coincident with a gradual rise in the level of the soil from this line westward up to the level of Raiganj." This Dr. Wilkie suggests "may have been the terminal phenomenon of a process that had gone on over the whole district gradually from east to west," which caused the fever by obstructing the drainage until "by the end of 1872 this progressive elevation had advanced so far as to reach the high lands in the west, and south-west the fever may be said to have ceased, because the land wave could no longer obstruct the drainage." Apart from the fact that this ingenious theory does not cover the whole of the country affected by the epidemic, Dr. Wilkie produces no evidence that such a remarkable event ever occurred, beyond the quotation above given, while he does not attempt to explain how this extraordinary phenomenon was caused, or how it never affected the course of the rivers of the district traversed by it.

Dr. Coates in criticising Dr. Wilkie's theory writes, "The whole history of the formation of the Gangetic delta shows that elevations only occurred by depositions from above," and further on "I conclude, that, therefore, that since these rivers have been embanked, and spilling over the country prevented, a special and exceptional elevation of the fever tracts has not occurred. I cannot but believe that, had there been any upheaval it would have favoured health and not disease, yet the fever is distinctly malarial and connected with, if not entirely caused by, evaporation from a decomposing surface or subsoil." And he continues: "I can only uuderstand this extra subsoil water evaporation to arise, not from land elevation but from river elevation above intervening land, and a consequent filtration outwards of this high level water towards the intervening low ground, and its evaporation in and around the villages there situated." He quotes two engineers one of whom writes: "The general bed of the Damuda is rising, that is silting up. The levels taken are of too recent a date to be relied on as data of permanent change. That Burdwan has materially elevated during the last century there is no evidence, but the present site is on a higher level than at a former period." The other engineer states that it appears that "the Bhagirathi, Matabanga, and Jelinghi have deteriorated in the last 50 years," but adds "it is quite possible that these may alternately deteriorate and improve again according to changes (which are great) in the main Ganges." Dr. Coates therefore suggests that the fever epidemic was due to the elevation above the surrounding country of these Gangetic delta rivers in succession from east to west.

This theory at least covers fairly accurately the area affected by the epidemic, but there is no evidence that these changes, which have been taking place very slowly for centuries were accentuated during the few decades during which this epidemic fever raged. Moreover, such an elevation could only have been a very few feet at the outside, yet Dr. Coates further writes: "Those villages closest to the Bhagirathi river were not affected, but those at some distance inland. The former would be on higher ground." To a supposed elevation of these rivers by a few feet, then, is attributed an epidemic fever, which carried off over half a million people in twelve years from the Burdwan district alone. The fever, however, did not appear on each side of the rivers, as they silted up in succession, as must necessarily have been the case if this theory was true; but, on the contrary, it spread steadily west up to and across the rivers, which had no effect whatever on its spread, except that "if a broad river intervenes in the path of the fever its progress is checked for a time" (Dr. Jackson). This absence of any relation of the details of the spread of the fever to the supposed cause is sufficient proof against this explanation.

On the remaining theory which attributes the epidemic to the obstruction of drainage by railway embankments, roads, etc., a great deal has been written. That such obstructions are capable of producing local exacerbations of malarial fever is undoubted, but it is a very different thing to attribute such a widespread epidemic as that under consideration to such causes. The question is a very important one, and instances have been reported in Burdwan and other districts in which local obstructions of drainage were followed by an increase of fever, which decreased on their removal. It is not, however, surprising that such instances should have been forthcoming during the long period over which the epidemic lasted in a country in which the greater part of the agriculture depends on the water being retained in the fields during a certain period by means of such bunds, and doubtless such cases occurred both before and after the epidemic fever period. The question is whether at the period of the epidemic such bunds were constructed in all the affected district just before the outbreak to such an extent as to have been the cause of each outbreak.

Let us see what was the opinion of the Sanitary Commissioner of Bengal, who himself spent long periods during two years in touring through the affected districts, and whose long report on the subject is a mine of carefully recorded facts as observed by himself. Dr. Jackson writes: "I regard the supposition that a line of railway embankment could, under any circumstances, originate a travelling epidemic like that in Burdwan as ridiculous and unworthy of serious consideration." And again: "I have invariably found that even when the road did cross the drainage line, the villages on either side were equally bad; and lastly, I have

found the fever just as virulent in places where no road existed, in both wet and dry localities." In one instance this theory was carried to such an extreme that the outbreak of fever in a certain place was actually attributed to the obstruction of the drainage by a road which had been estimated for, but never constructed. Dr. Jackson also found the fever in dry parts with a water level far below the surface of the ground (20 feet), and indeed he states that the fever is often more virulent, but of shorter duration in such places. It is evident, then, that no physical cause has been proved to exist throughout the large area covered by this epidemic fever, which can account for its incidence, by having caused a waterlogging of the soil, advancing coincidently with the progress of the fever, and ceasing as it died out.

The remaining theory is that the fever spread by means of direct or indirect infection, only limited by lines of communication, and an alluvial soil. Evidence in support of this view may be of two kinds, which will be separately considered:—

(1) The distribution and spread of the disease may be such that it can only be explained on the ground that the disease is carried from place to place by human intercourse.

(2) Specific instances where there is strong evidence of the disease having been infectious.

There is abundant evidence of the first class, the only difficulty being in the selection of quotations from the reports of the various medical men who have written on the subject. Thus Dr. French, after recording his opinion that the disease was an intense form of malarial fever, which local conditions were insufficient to account for, writes: "There is one thing certain about the fever, it progresses steadily, although slowly; in some years it has come east and south-east, regularly west and north-west; it has followed like a rolling wave the chief roads and lines of communication; and it is steadily going on to the west and north-west." The Civil Surgeon of Serampore writes:—"There is no doubt that the fever seems to follow the tracts of the main and branch roads of the district originating at Jehanabad, on the other side of the Damuda; the disease can be distinctly traced along the old Benares road, which ends at Sulkea above Howrah. There is no doubt that the fever has been carried along this road to Howrah," and he illustrates his remarks by a map.

Dr. Barker of Birbhum, in 1872, in a remarkable report, after discussing the very insanitary state of the villages of that district, continues: "Perhaps it is another instance of that state of things which requires a new element to quicken into action. It is difficult to say whether this element was introduced into the district through air or water or through human intercourse. That some such element was imported, is but too evident from the absence of fever in previous years when the same sanitation prevailed," and again in 1873 "I hold the opinion expressed before that the disease was not generated here but introduced from without;" and admitting that the fever is a malarious one, he writes:—"It is hard to disassociate one's mind from early scientific training but facts are stubborn things, and plainly point to the fever being communicable;" a truly scientific way of looking at the question, and one which, had our present knowledge of malarial and other specific fevers been then available, would have assuredly lead him to a correct conclusion.

It is, however, in the writings of Dr. Jackson that the most conclusive evidence on this head is to be found, and his views are all the more valuable in that they are founded on a perhaps unique experience of the fever in various districts. He traces the disease year by year, and shows how true areas, one low and moist, and the other somewhat higher and drier than the average, but both similar in the respect that they were cut off from active communication with the infected districts around them by physical conditions such as jheels, rivers, or absence of roads, entirely escaped the disease. He records an instance in which numbers of the people of certain unaffected villages "preferred losing their law suits to incurring the risk of visiting Jehanabad," an affected place. After discussing the spread of the fever from Nadia into Burdwan he writes: "From a consideration of the above facts, I conclude that the fever was imported into Burdwan, and that if there had been no connection and communication between the people of the thannahs Culna and Poorbusthali and the fever-stricken villages of Nadia, there would have been no fever," and he sums up "wherever there has been active intercourse, the fever had travelled; where there has been little or none, it has died out. . . . It will be seen from the foregoing remarks that while I believe the fever to be malarious in its origin, and to have some malarious characteristics, I believe it to be not a mere or simple, but a contagious malarious fever; that is probably typho-malarial, and that it has not been produced in Burdwan, but imported, and again carried from Burdwan into Birbhum, and its behaviour under the various conditions observed are quite incompatible with it being simply malarious locally produced or non-contagious." As the above was written in 1873 doubtless Dr. Jackson uses the term "typho-malarious" in its old sense of malignant malarial fever, and this is in agreement with every other writer on the subject, with whom I am acquainted in regarding the fever as essentially malarial in its nature. Thus Dr. Joubert, when Civil Surgeon of Burdwan in 1879, writes: "I am of the opinion that it was a purely malarious fever locally intensified into a very virulent type. . . . All those who have had opportunities of studying

the disease thoroughly hold the same opinion that it was purely a malarial fever."

Coming now to the question whether any instances are on record of the fever being infectious, it may first be pointed out that the disease usually began in an insidious manner in any place, and that "the year of invasion is never the year of intensity. The fever is generally present for a year without attracting attention" (Dr. Jackson). Nor is this surprising when we consider that the fever is a malarial one, introduced into notoriously malarial districts, and only differing from the ordinary malarial fever by its greater intensity and fatality, and in its being carried by human intercourse along lines of communication. When we remember the great difficulty of tracing the exact mode of spread, and even the manner of introduction, into a country previously free from them of such well marked diseases, influenza and plague, which are generally recognised as communicable or infectious diseases, how much more difficult will it be to trace the exact introduction of the Lower Bengal epidemic malarial fever into villages in which malaria is endemic. It must also be borne in mind that at the time of which I am writing (as is also the case to a very large extent at the present date) the very fact that a fever was thought to be malarial was held to exclude the possibility of it being infectious, so that such a mode of spread of the disease would not only not be sought for, but if any apparent instances of infection taking place were met with, some other explanation of the facts would be looked for. Nevertheless, in spite of all these difficulties, numerous cases of infection are recorded by Dr. Jackson, all of which came under his personal observation. Only one or two instances need be recorded here. Thus he, in the account of his tour in the affected districts in 1873, writes: "Neema I found to be an insignificant little village of only 9 houses, containing at the time of my visit 65 people; but during the preceding year, 1872, there had been 21 deaths. The people's account of the visitation was this. In May 1872 some men belonging to the village, who had been employed in the country south of the More, where fever was prevalent, returned sick with fever to the village. The other inmates of their houses then began to suffer, and in a little time all the inhabitants were attacked. Some of them had friends at Kotasore (two miles west), and asked them to come and nurse them; but those who came were also attacked, returned with the fever on them to Kotasore, hitherto free from the disease, and it began to spread there in the same manner. This was a volunteered statement. Kotasore was also visited and the latter part of the above statement was corroborated by the inhabitants. Once more it must be borne in mind that there is a kind of intercourse between infected and uninfected districts, which is the necessary consequence of the prevalence of fever. Sickness and death during the outbreak put so many of the labouring classes *hors de combat*, that much of the annual crop would be lost unless extraneous assistance were procured. For this purpose the neighbouring uninfected villages are resorted to; a few labourers are obtained from each of the places around, and it is a common history that the people so employed return to their own houses with the fever, and introduce it among their own people.

Enough has been written to show that while none of the theories of local origin of the epidemic in each district due to local physical changes are supported by facts which cover the whole origin and course of the epidemic, yet, on the other hand, there is ample evidence that the disease was spread by means of human intercourse along lines of communication, and instances of undoubted infection are not wanting. In fact, it was nothing but the dogmatic opinion that malarial fever could under no circumstances become communicable which prevented this explanation of the steady spread of the disease being accepted. What was an insuperable difficulty twenty-five years ago, when the malarial organism was unknown, while the science of bacteriology was in its infancy, is at the present time easily explicable in the light of modern researches. I will first state my view of the epidemic as a whole and then briefly give the arguments in favour of it, derived from recent advances in our knowledge.

I hold that the Lower Bengal malarial fever epidemic arose in Jessore by an intensification of the ordinary fever of that very malarious district during the first half of this century by means of extraordinary physical causes (in this case either from silting up of the river Bhyrub or from this cause combined with abnormal variations in the rainfall in certain years), until it attained to the power of infection, and that it spread slowly from Jessore through the other affected districts as a wave of increased mortality due to this intense communicable type of malarial fever, as long as it found a suitable (alluvial) soil for its propagation, and lines of communication along which it could be spread by means of human intercourse. If the names and dates only be altered this will be found to be precisely the conclusion that I have come to regarding the nature of the Assam epidemic of malarial fever ("Kala-azar"), only in the latter case I have been able to furnish much more conclusive evidence of the infectiousness of the disease and also concerning its exact origin. The arguments in favour of this view, which are given in the 9th section of my report on "Kala-azar" equally apply to the Lower Bengal or "Burdwan fever" epidemic, so they will only be very briefly indicated here.

That the prevalence and intensity of malarial fevers vary greatly from year to year in the

same districts in accordance with seasonal causes, usually excess or deficiency of the rainfall, is well-known. If two unhealthy years succeed each other something approaching to local epidemic of malarial fever may occur. Is it then surprising that three or more successive unseasonal years, such as could only very seldom occur may produce a spreading epidemic, or that the succession of five out of six years of greatly deficient rainfall in the early seventies should have started the Rangpur-Assam epidemic which is still actively spreading up the Brahmaputra valley, or that a rapid silting up of the main river of such a district as Jessore might originate a similar epidemic? Such epidemics have doubtless occasionally occurred for centuries past. The difficulty of proving by direct evidence the introduction and spread of an intensified and infectious form of malarial fever into a notoriously malarious district by human intercourse is necessarily well nigh insuperable, but that a malarial fever may be introduced into an island previously free from it by means of human intercourse and may there spread in the form of an epidemic is proved by the case of Mauritius and Réunion. Up to 1865 malarial fever was unknown in these islands, and is still unknown in the neighbouring island of Rodrigues. At the date mentioned it was introduced by coolies from India, and such a fearful epidemic ensued, that one-third of the inhabitants of the islands are said to have died in the course of four years, while in 1867 alone there were 31,920 deaths out of a population in the area affected not exceeding 130,000. Moreover, the disease remains there to the present day but in a milder form. It is worthy of note that this epidemic took place at the very time that the "contagious malarial fever" was raging in Burdwan, and although I have not yet been able to ascertain whether any of the Indian coolies, who are said to have carried the disease to Mauritius, actually came from the infected areas in Bengal, yet I venture to suggest that this was very likely the origin of the Mauritius outbreak. This proposition is to some extent supported by the following opinion recorded by Dr. French when writing in 1871 of the Burdwan epidemic, "it appears to me to be identical with the epidemic fever of the Mauritius of 1866-67."

It must be carefully noted that I do not say that all malarial fevers are infectious, but only that, under extraordinary circumstances, malarial fevers may be intensified until they become so, and may then be spread by human intercourse to places situated on a suitable soil. This explains all the facts of both the Lower Bengal and Rangpur-Assam outbreaks. Unfortunately it is incapable of scientific demonstration as long as we are unable even to cultivate the malarial organism, but it derives much support from recent bacteriological work on other germ diseases. Leaving on one side all the instances in which the germs of disease have been artificially intensified, let us take the case of pneumonia, which ordinarily is not an infectious disease, yet every now and then it becomes so, and attacks whole families, or large numbers of a regiment, as occasionally happens on the North-West Frontier of India, where instances have occurred of sick attendants over other cases being struck down by the disease, which has in sometimes only been eradicated when the troops were placed under canvas. The relation of Pestis minor to true plague appears to be a similar instance.

In the same way I maintain that in the case of travelling epidemics of malarial fever, the germs of the disease have become intensified, as it were in Nature's laboratory, by conditions unusually favourable to their vitality, until they attain to the power of being communicated from one person to another either directly through the air, or indirectly after passage through the soil. I shall not attempt to give here my views as to the exact way in which the infection takes place, as I hope to do so in another place, and this paper has already exceeded the limits I had intended.

The hope of being able to throw any light on the vastly important subject of the Lower Bengal malarial fever epidemic must be my excuse for raking up such a much discussed, but now partly forgotten, subject.

Dr. ROGERS' REPORT ON KALÁ-ÁZÁR.

The following is an abstract of remarks by Surgeon-Colonel A. Stephen, M.B., Principal Medical Officer and Sanitary Commissioner, Assam, in a letter forwarding the above report to the Secretary to the Chief Commissioner of Assam:—

Leaving Calcutta on the 16th of April 1896, Dr. Rogers visited Dhubri, Gauhati, Shillong and Tezpur, in order to learn the views of the Civil Surgeons of those places on the disease which he was about to investigate, and in due course arrived at Nowgong, the capital of the district in which the disease was at that time most prevalent, and which he was requested to consider as, for the time being, his head-quarters. He spent the next five months in the Nowgong District in investigating the disease. During these months he studied the cases of the disease which he met in the Nowgong dispensary and jail, and in a large number of infected places in that district, including a considerable number of tea-gardens. In October he proceeded to Shillong in order to study the minute pathology of the organs of persons who had died of *kalá-ázár* in the Nowgong District, and on whom he had performed *post-mortem* examinations. He afterwards visited Sylhet to study cases of ordinary chronic malarial fever there, and to notice the differences, if any, between them